GUJARAT TECHNOLOGICAL UNIVERSITY

ENERGY ENGINEERING (39)

EXERGY ANALYSIS OF THERMAL SYSTEMS

SUBJECT CODE: 2743903

SEMESTER: II

Type of Course: Applied Engineering (Advanced)

Prerequisite: Fundamental knowledge of thermodynamics and energy analysis of thermal components and power cycle

Rationale: The course is design to impart detailed study of exergy analysis of various thermal systems and exergy-economics.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA(I)		
						ESE	OEP	PA	RP	
3	2#	0	4	70	30	30	0	10	10	150

Content :

Sr. No	Topic	Total Hrs	% Weightage
1	**Exergy Destruction:** Lost available work referred to heat engine cycle, refrigeration cycle, heat pump cycle, non flow and steady flow processes, Mechanism of exergy destruction, modified Gouy-Stodola theorem, concept of effective temperature	5	12
2	**Exergy Analysis of Simple Processes**: Mixing and separation process of fluids of different temperature, heat transfer across a temperature difference, expansion and compression process, combustion process	9	21
3	**Exergy Analysis of Power Plant Cycles:** Maximum power subject to size constraint with fixed heat input and its application to Brayton cycle Steam turbine power plants: External and internal irreversibility, superheater, reheater, vacuum condenser, regenerative feed water heating, combined feed water heating and reheating Gas turbine power plant: External and internal irreversibility, regeration, reheater, and intercooler, combined steam and gas turbine power plant	14	35
4	**Exergy analysis of Refrigeration cycle:** Joule-Thomson Expansion, Work-Producing Expansion, Brayton Cycle, Optimal Intermediate Cooling, Exergy analysis of Air-conditioning applications: Mixtures of air and water vapour, total flow exergy of humid air & liquid water, Evaporative cooling process and other aspects	6	14
5	**Exergy-economic Analysis:** Fundamental of exergy-economics, exergy costing of different thermal components: steam or gas turbine, boiler, cogeneration system	8	18

References:

1. Advanced Engineering Thermodynamics by Adrian Bejan, John Wiley & Sons, Inc.
2. The Exergy Method of Thermal Plant Analysis by T J Kotas, Krieger Publishing Company
3. Thermal Design and Optimization by Adrian Bejan, George Tsatsaronis, Michael Moran, John Wiley & Sons, Inc.
4. Advance Thermodynamics for Engineers by Winterbore D E, Arnold Publication
5. Advanced Thermodynamics for Engineers by Kenneth Wark, McGraw Hill Publishing Co. Ltd.
6. Fundamentals of Engineering Thermodynamics by Michel J Moran, Howard N Shapiro, Daisie D Boettner, Margaret B Bailey, John Wiley & Sons, Inc.

Course Learning Outcome:

After successful completion of the course, the student will be able to:

- Acquire an overview of exergy analysis of thermal components
- Able to compute exergy analysis of different processes and power and refrigeration cycles
- Calculate exergy-economics costing of thermal components

Term Work:

- Visit any thermal power plant, obtain the sample data and compute exergy destruction of various component and of the plant
- Visit any refrigeration plant, obtain the sample data and compute exergy destruction of various component and of the plant

List of Open Source Software/learning website:

- Students can refer to video lectures available on the websites including NPTEL.
- Students can refer to the CDs which are available with some reference books for the solution of problems using software/spreadsheets.

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.